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In re Application of

WILLIAM J. ALLEN, WINTHROP D.  
CHILDERS and CLEMENT C. LO

HP Docket No. 10015643-1

Serial No. : 10/062,644

Examiner P. Natnael

Filed : January 31, 2002

Group Art Unit 2614

For : DISPLAY DEVICE WITH COOPERATIVE COLOR FILTERS

Commissioner for Patents  
P. O. Box 1450  
Alexandria, Virginia 22313-1450

Sir:

#### DECLARATION UNDER § 1.131

We declare as follows:

1. We are inventors who, on January 31, 2002, filed the above-identified application. At the time of such invention, we were employees of Hewlett-Packard Company.

2. Prior to December 31, 2001, the effective date of the application from which U.S. Patent No. 6,813,087 issued to Davis matured, we conceived of our invention, and diligently worked toward reducing our invention to practice, as demonstrated by the Invention Disclosures attached to this declaration.

3. Invention Disclosure 10015643 (which has a descriptive title "Dynamic Gamut via Filter Wheels for Digital Projector") is attached hereto as Exhibit 1. As indicated, Invention Disclosure 10015643 was prepared at least as early as April 24, 2001.

4. Invention Disclosure 10019415 (which has a descriptive title "Variable Gamut via Locked Together Dual Color Wheels for a Digital Projector") is attached hereto as Exhibit 2. As indicated, Invention Disclosure 10019415 was prepared at least as early as July 30, 2001.

5. At the time of preparing Exhibits 1 and 2, which preceded December 31, 2001, we had conceived of a display device including: an illumination source configured to direct light along an optical path; a first color filter having a first number of color regions; and a second color filter having a second number of color regions; wherein the first and second color filters are configured so as to selectively adjustably cooperate in sequentially filtering the directed light to display an image.

6. We also had conceived of a display device including an carriage configured to selectively position either the first color filter or the second color filter in the optical path.

7. We also had conceived of a display device including an optical path director configured to selectively direct the optical path through either the first color filter or the second color filter.

8. We also had conceived of a method of displaying an image, the method including: providing an illumination source; directing light from the illumination source along an optical path; and sequentially filtering the directed light with at least one of plural cooperative color filters by selecting a first color filter, fixing a position of a second color filter in a predetermined position in the optical path and moving the first color filter relative to the optical path.

9. We also had conceived of a method of displaying an image, the method including: providing an illumination source; directing light from the illumination source along an optical path; and sequentially filtering the directed light with at least one of plural cooperative color filters by altering the optical path to coincide with a selected one of plural color filters.

10. We also had conceived of a sequential color filter system for filtering light directed along an optical path, the sequential color filter system including: a first color wheel having a plurality of color regions; and a second color wheel having a plurality of color regions including at least one white region; each of the first and second color wheels being individually selectable to sequentially filter the light directed along the optical path.


11. We also had conceived of a display device including: an illumination source configured to direct light along an optical path; a first sequential color filter means disposed along the optical path; and a second sequential color filter means disposed along the optical path; one of the first sequential color filter means and the second sequential color filter means being selectable for individual movement through the optical path to effect adjustable sequential filtering of the directed light to display an image.

12. Following our conception prior to December 31, 2001, we diligently worked toward reducing our inventions to practice, and on January 31, 2002, filed the present patent application.

13. All acts set forth herein and/or relied upon for the purpose of establishing invention prior to December 31, 2001 were carried out in the United States.

14. We declare that all statements made herein of our knowledge are true and all statements made on information and belief are believed to be true. These statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment or both under § 1001 of Title 18 of the United States Code. We understand that such willful false statements may jeopardize the validity of the application or any patent issuing therefrom.

Date: 24 JUN 05

  
\_\_\_\_\_  
William J. Allen

Date: \_\_\_\_\_

\_\_\_\_\_  
Winthrop D. Childers

Date: \_\_\_\_\_


\_\_\_\_\_  
Clement C. Lo

14. We declare that all statements made herein of our knowledge are true and all statements made on information and belief are believed to be true. These statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment or both under § 1001 of Title 18 of the United States Code. We understand that such willful false statements may jeopardize the validity of the application or any patent issuing therefrom.

Date: \_\_\_\_\_

\_\_\_\_\_  
William J. Allen

Date: June 10, 2005

  
\_\_\_\_\_  
Winthrop D. Childers

Date: \_\_\_\_\_

\_\_\_\_\_  
Clement C. Lo

14. We declare that all statements made herein of our knowledge are true and all statements made on information and belief are believed to be true. These statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment or both under § 1001 of Title 18 of the United States Code. We understand that such willful false statements may jeopardize the validity of the application or any patent issuing therefrom.


Date: \_\_\_\_\_

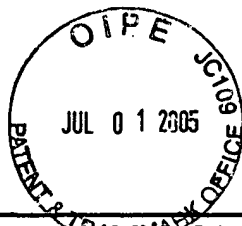
\_\_\_\_\_  
William J. Allen


Date: \_\_\_\_\_

\_\_\_\_\_  
Winthrop D. Childers

Date: 6/14/05

  
\_\_\_\_\_  
Clement C. Lo



	<b>INVENTION DISCLOSURE</b> (WKRP Document No. 20010404.215500)		<b>Done Printing Document</b>
	PD Number: 10015643	Date Received by Legal: 4/24/01	Managing Attorney: Rose, Curtis
	Invention Disclosure status: Awaiting PD Number PD Number Assigned - Ready to Send to Patent Coordinator		
<b>General Information   Description of Invention   Invention History   Inventor Information   Witness Information   Additional Information   Administrative Record   Review Record</b>			

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## General Information

Section Complete

**Title:** Write a descriptive title of the invention.

Dynamic Gamut via Filter Wheels for Digital Projector

**Abstract:** Write a brief abstract of the invention.

Existing sequential color digital projectors use one of two color wheel schemes depending on the intended use of the projector. One scheme delivers a gamut with a better white point at the expense of chroma, while the other trades off white for better chroma. The invention details a novel scheme for using two wheels in a product to allow the projector to easily switch from one optimization scheme to the other. Customers can use one projector to display video with a video optimized gamut and and display data with a gamut optimized for data.

[REDACTED]

[REDACTED]

[REDACTED]

## Description of Invention

Section Complete

[REDACTED]

Projector hardware has a fixed gamut. Some machines have a gamut optimized for video in controlled lighting, others are optimized for data display.

[REDACTED]

projection system can be realized by automatically controlling the color gamut selection based on image content and ambient conditions.

[REDACTED]

A single projector can adjust the shape of its gamut depending on image content and viewing conditions.

[REDACTED]

A single projector with the invention does the job of two that don't have it. Implementation is straightforward, easily quantifiable in terms of size, weight, cost, and benefit. Existing designs in the market serve as proof of concept for the invention. Easy to market: DynamicGamut (tm) and easy to demonstrate benefits.

**Description:** Describe the construction and operation of the invention.

Refer to attached Dynamic Gamut.ppt

Figure 1 shows a conventional color wheel optimized for video display in controlled lighting. The wheel has three segments, one for each primary color. This design has lots of chroma, but has a limited maximum brightness (white point).

Figure 2 shows a convention data display wheel. The white segment allows lots of light to reach the screen, increasing maximum brightness. This comes at the expense of the other three segments, effectively reducing the intensity of the three primaries. This reduces the maximum chroma.

One implementation would be to put two wheels in the projector. You could move one or the other wheel into the optical path, depending on which is desired. Alternatively, the optical path could be moved (mirrors or prisms) through the desired wheel.

A twist on the previous implementation would be to have a single wheel with both patterns (Figures 1 and 2) on it. The two patterns are concentric, one outside the other. Either the wheel or optical path is moved so as to cause the light to pass through one pattern or the other. If the filter wheel is upstream of the integrator rod, the optical path could be positioned so as to pass through some each pattern, resulting in an infinite set of intermediate gamuts.

An different implementation is possible where neither wheels nor the optical path are moved. See Figure 3. Two wheels are used. For data display, Wheel B is stopped with light passing through the white (clear) segment. This effectively takes wheel B out of the system. The area through which the light passes in the wheel is naturally small in typical systems, so only a small angle of Wheel B must be white. Wheel A is a "classic" RGBW data wheel. Since wheel B is stopped at a clear segment, only wheel A is in effect.

This concept is easily extended to multiple wheel, each with a filter set that is optimized to give a particular gamut.

When a less bright, higher chroma gamut is desired, Wheel A is stopped on its white segment, and Wheel B spins. Wheel be is almost the same as the high chroma wheel shown in Fig 1. A small section given to white. It is probably possible to adjust the optics so as to reduce the area on Wheel B through which the light passes, thereby reducing the percent of the wheel lost to white.

The selection of gamut shape is easily automated. Assume there are two available gamut shapes: HP (high brightness), HC (high chroma). If data is supplied via a VGA data port, then the HP gamut is selected. If data is supplied via the S-Video port, or via the composite video jack, then HC is selected. In a more sophisticated implementation, incoming data is analyzed, and is determined to be data or video. The analysis result is used to select HP or HC. This is an extension of the HP's Color Smart patent (5,731,823) to projection.

## Invention History

Section Complete

**Published:** Was a description of the invention published, or are you planning to publish? If so, when and in what publications?

Published: No

**Announced:** Was a product including the invention announced, offered for sale, sold, or is such activity proposed? If so, when and where?

Announced: No

**Disclosed:** Was the invention disclosed to anyone outside of HP, or will such disclosure occur? If so, when and to whom?

Disclosed: No

**Urgency:** Will the invention be published, announced, or disclosed in the next 3 months?

No

**Described:** Was the invention described in a lab book or other record?

Described: No

**Built:** Was the invention built, modeled, or tested? If so, when?

Built: No



**Government Contract:** Was the invention made under a government contract?  
If so, the agency and contract number:

Government Contract: No

## Inventor Information

Section Complete

**Inventor(s):** Pursuant to my (our) employment agreement, I (we) submit this disclosure:

Allen, William (Will)  
[00241273]  
Corvallis, OR, USA

**Inventor Home Addresses:** Enter the home address of each inventor. This information is legally required to process your Invention Disclosure.

Inventors	Home Street Address	City	State/Province	Zip/Postal Code	Country
Allen, William (Will)	[REDACTED]		OR	97333-1533	United States [US]

**Inventor Citizenships:** Select the country of citizenship for each inventor.

Inventors	Country of Citizenship
Allen, William (Will)	United States [US]

**Inventor Mail Stops:** Enter the HP Mail Stop for each inventor.

Inventors	HP Mail Stop
Allen, William (Will)	1032B

**Non-HP Inventors:** Please list the names, home addresses, telephone numbers, email addresses, and countries of citizenship of inventors who are not affiliated with HP.

## Witness Information

Section Complete

**Witnesses:** This invention has been explained to and understood by the following witnesses. You must name at least two witnesses.

Gorzynski, Mark E  
[00436603]  
Corvallis, OR, USA

Orr, David [00307194]  
Corvallis, OR, USA

**Witness Dates:** At what date was this invention first explained to and understood by each witness?

Witnesses	Date Understood
Gorzynski, Mark E	April 19, 2001
Orr, David	April 6, 2001

**Additional Information**

Section Complete

**Electronic Documents:** Do you have electronic document files to upload? Please convert your documents into MS Word, PowerPoint, Adobe Acrobat, or plain text format.

**File Name**

Click to View

Dynamic\_Gamut.ppt (PDF)

**Size**

Bytes

17920

**Uploaded**

Date

4/6/01

**Uploaded By**

User

Allen, William (Will)

**PDF Renditions:** Upload PDF renditions of any files that have been attached to this Invention Disclosure.

**Paper Documents:** Do you have paper documents to include with your Invention Disclosure that you would like to send by FAX?

**FAXed Attachments:** Attach any paper documents that have been FAXed in to this Invention Disclosure.

**Categories:** Select WKRP categories where this invention disclosure should be indexed.

Digital Projection

**Keyword(s):** Select keywords to index this invention disclosure.

projection, gamut, color space, color wheel

**Innovation Workshop:** Was this Invention Disclosure prepared as a result of an Innovation Workshop? If you are not sure, select No.

No

**Related to a Previous Submission:** Does this disclosure relate to a previously submitted disclosure? If so, please provide the PD number of the related disclosure and explain.

**Administrative Record**

Section Complete

**Patent Clerk:** Select the name of the Patent Clerk(s) working on this Invention Disclosure:

Isagawa, Michiko [00528430]  
San Diego, CA, USA

**PD Number and Legal Received Date:** Record the PD number assigned by Merlin and modify the date this disclosure was received, if necessary.

PD Number: 10015643

Date Received by Legal: April 24, 2001

**Patent Coordinator(s):** Select Patent Coordinator(s) who will work on this Invention Disclosure:

Valley, Jeffrey M [00255954]  
Corvallis, OR, USA

**Managing Attorney(s):** Select Managing Attorney(s) assigned to this Invention Disclosure:

Rose, Curtis [00202368]  
Corvallis, OR, USA

**Legal Entity and Site:** Select a Legal Entity and Site where this Invention Disclosure will be handled and reviewed:

Legal Entity: IJS

Legal Site: Corvallis

### Review Record

2 Required Fields Remaining

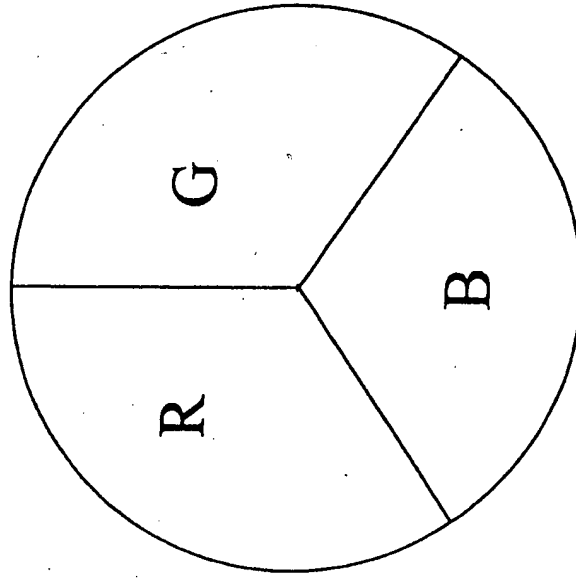
**Assigned Reviewer:** Select the name of the Reviewer(s) who will review this disclosure before the Site Review Committee meeting:

**Functional Segment:** Select the functional segments in which this disclosure will be reviewed:

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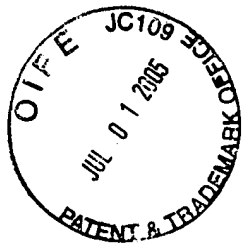


# Dynamic Gamut

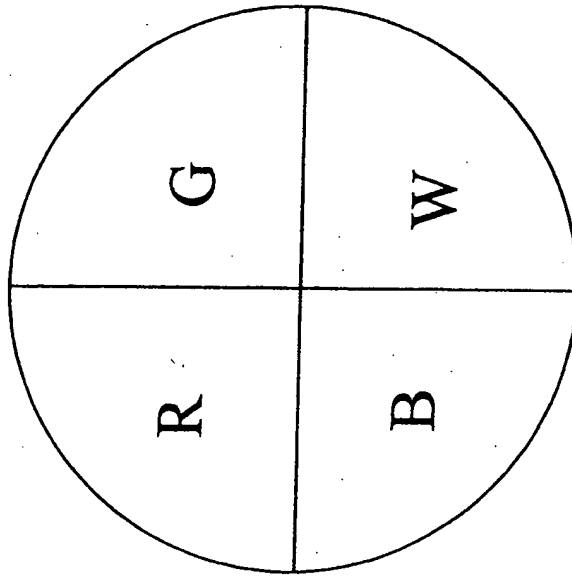


Conventional Single Wheel  
Optimized For Video in Controlled Light

Fig 1



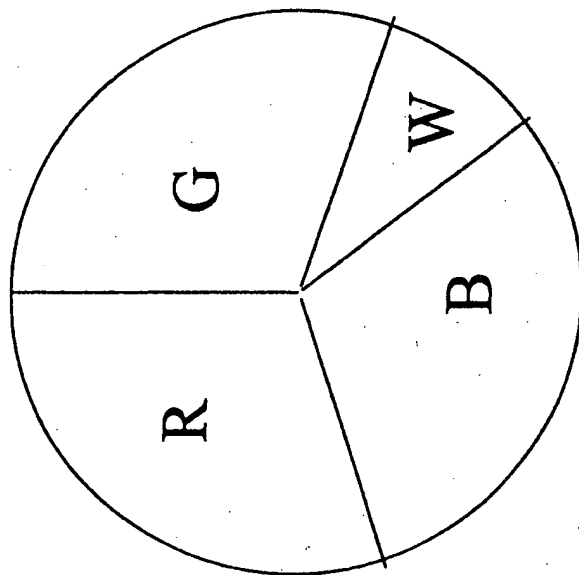
# Dynamic Gamut



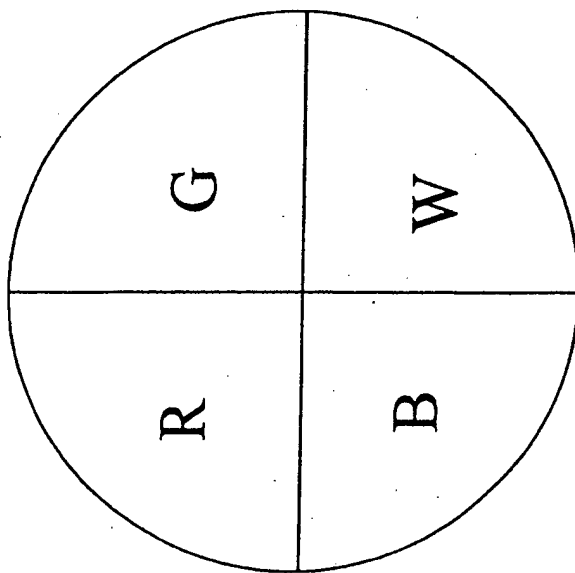
Conventional Single Wheel  
Optimized For Data

Fig 2

# Dynamic Gamut



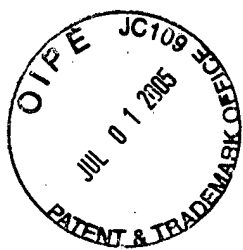
Wheel B




Wheel A

Dual Wheels

Fig 3



	<b>Invention Disclosure</b>		<b>Done Printing</b>
	(WKRP Document Number 20010726.085612)		
PD No. 10019415	Date Received by Legal 7/30/01	Managing Attorney Dennis G Stenstrom	

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### General Information

Write a descriptive title of the invention.

Variable Gamut via Locked Together Dual Color Wheels for a Digital Projector

Write a brief abstract of the invention.

An illumination system for a projector includes two color wheels in the same optical path. The wheels lock together with varying degrees of alignment relative to each other to provide a tradeoff between chroma and brightness. (This invention is inspired by 10015643.)

[REDACTED]

[REDACTED]

### Description of Invention

[REDACTED]

Projector systems that utilize color wheels typically have a single wheel offering a fixed gamut. Traditionally, the color wheels are purely RGB. The problem with this is brightness in some environments. To improve brightness, color wheels have incorporated clear or white sections (white for more diffuse lighting). However, this is at the expense of chroma.

[REDACTED]

An illumination system is provided for a projector. This illumination system allows a broad range of solutions for trading off color gamut and brightness.

[REDACTED]

The present invention provides a way of building a flexible projector that works for applications where chroma is more important (a very dark room and/or applications where color gamut is most important) or where brightness is more important (a not so dark room and/or where sharp boundaries between light and dark are important).

**Describe the construction and operation of the invention.**

See attached file

### **Invention History**

**Was a description of the invention published, or are you planning to publish? If so, when and in what publications?**

No

**When was this invention published?**

**Describe the details of the publication of this invention**

**Was a product including the invention announced, offered for sale, sold, or is such activity proposed? If so, when and where?**

No

**When was this invention announced, offered for sale, or sold?**

**Describe the details of the announcement of this invention.**

**Was the invention disclosed to anyone outside of HP, or will such disclosure occur?**

No

**Date this invention was or will be disclosed:**

**Describe the details of the disclosure of this invention. To whom will/has it been disclosed?**

**Will the invention be published, announced, or disclosed in the next 3 months?**

No

**Was the invention described in a lab book or other record?**

No

**Where, when, and how was this invention described?**



Was the invention built, modeled, or tested? If so, when? No
When was this invention built?
Was the invention made under a government contract? If so, the agency and contract number: No
Give the agency and contract number:

Inventor Information						
Pursuant to my (our) employment agreement, I (we) submit this disclosure:						
	Employee Number	Location Code	Telnet	E-Mail	Site	
Winthrop D Childers	[REDACTED]	[REDACTED]	[REDACTED]	[REDACTED]	San Diego, CA, US	
William (Will) Allen	[REDACTED]	[REDACTED]	[REDACTED]	[REDACTED]	Corvallis, OR, US	
Clement C Lo	[REDACTED]	[REDACTED]	[REDACTED]	[REDACTED]	Vancouver, WA, US	
Enter the home address of each inventor. This information is legally required to process your Invention Disclosure.						
	Home Street Address	City	State or Province	Zip or Postal Code	Country	
Winthrop D Childers	[REDACTED]	San Diego	CA	92127	United States [US]	
William (Will) Allen	[REDACTED]	Corvallis	OR	97333-1533	United States [US]	
Clement C Lo	[REDACTED]	Lake Oswego	OR	97305	United States [US]	
Select the country of citizenship for each inventor.						
	Citizenship					
Winthrop D Childers	United States [US]					
William (Will) Allen	United States [US]					
Clement C Lo	United States [US]					

Type the HP Mail Stop for each Inventor.

Winthrop D Childers  
William (Will) Allen  
Clement C Lo

Mail Stop  
61U66  
1032B  
1

Please list the names, home addresses, telephone numbers, email addresses, and countries of citizenship of inventors who are not affiliated with HP.

### Witness Information

This invention has been explained to and understood by the following witnesses (you must name at least two witnesses).

Charles B (Charlie) Chapman  
Noah Lassar

At what date was this invention first explained to and understood by each witness?

Charles B (Charlie) Chapman  
Noah Lassar

Date Understood  
July 26, 2001  
July 26, 2001

### Attachments

Do you have electronic document files to upload? Please convert your documents into MS Word, PowerPoint, Adobe Acrobat, or plain text format.

File	Uploaded
Dual_Color_Wheels_Improvement.doc	7/27/01 8:24AM by Winthrop D Childers

Do you have paper documents to include with your Invention Disclosure that you would like to send by FAX?

### Additional Information

Select WKRP categories where this invention disclosure should be indexed.

Select keywords to index this invention disclosure.

projectors and illumination

<p><b>Was this Invention Disclosure prepared as a result of an Innovation Workshop? If you are not sure, select No.</b></p> <p>No</p>
<p><b>Does this disclosure relate to a previously submitted disclosure? If so, please provide the PD number of the related disclosure and explain.</b></p> <p>Yes</p>
<p><b>What is the PD Number of the disclosure this one is related to?</b></p> <p>10015643</p>
<p><b>Explain how this disclosure is related to a previous one</b></p> <p>This disclosure is an extension or modification of 10015643.</p>

<b>Administrative Record</b>
<p><b>Select the name of the Patent Clerk(s) working on this Invention Disclosure:</b></p> <p>Michiko Isagawa</p>
<p><b>Select the name of the Legal Admin(s) working on this Invention Disclosure:</b></p> <p>Ann Lygas</p>
<p><b>Record the PD number assigned by Merlin and modify the date this disclosure was received, if necessary.</b></p> <p>10019415</p>
<p><b>Enter the legal received date:</b></p> <p>July 30, 2001</p>
<p><b>Select the name of the Patent Coordinator(s) who will work on this Invention Disclosure:</b></p> <p>Winthrop D Childers</p>
<p><b>Select the name of the Managing Attorney(s) assigned to this Invention Disclosure:</b></p> <p>Dennis G Stenstrom</p>
<p><b>Select a Legal Entity and Site where this Invention Disclosure will be handled and reviewed:</b></p> <p>IJS</p>
<p><b>Please select a Legal Site:</b></p> <p>San Diego</p>

## Variable Gamut via Dual Color Wheels for Digital Projector

Win Childers  
Will Allen  
Clement Lo

7/25/2001

**Abstract:** An illumination system for a projector includes two color wheels in the same optical path. The wheels lock together with varying degrees of alignment relative to each other to provide a tradeoff between chroma and brightness. (This invention is inspired by 10015643.)

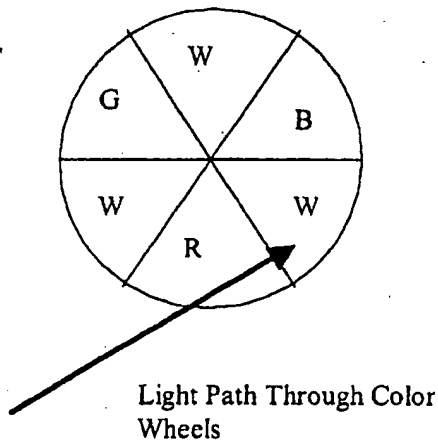
Projector systems that utilize color wheels typically have a single wheel offering a fixed gamut. Traditionally, the color wheels are purely RGB. The problem with this is brightness in some environments. To improve brightness, color wheels have incorporated clear or white sections (white for more diffuse lighting). However, this is at the expense of chroma.

The present invention provides a way of building a flexible projector that works for applications where chroma is more important (a very dark room and/or applications where color gamut is most important) or where brightness is more important (a not so dark room and/or where sharp boundaries between light and dark are important).

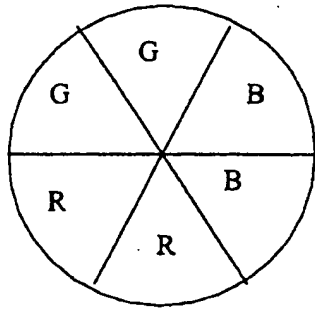
### Description:

This is an extension or modification of disclosure 10015643 which describes the use of two color wheels to enable switching between one color wheel providing high chroma (all or mostly RGB) and another wheel enabling high brightness (with a white or clear section). For the present invention, there are preferably two or more color wheels, but they don't have to be different.

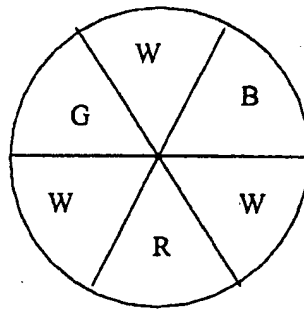
In one embodiment, there are two wheels of the following type:



The two wheels overlay one another and are clamped together, so that they spin together. The relative rotational positioning of the wheels determines the tradeoff between chroma and gamut. For maximum chroma, the color sections (RGB) are aligned with the clear or white (W) sections. For maximum brightness, each color section is aligned with the same color. These variations are illustrated below.



Maximum Chroma  
with 60 degree  
misalignment of  
wheels.



Maximum  
Brightness with  
Perfect Alignment of  
Wheels

There are also a number of intermediate relative positions of the wheels that provide a continuous tradeoff between chroma and brightness.

In a preferred embodiment, the wheels "lock" and spin together as a unit at any relative position between alignment and 60 degree misalignment of the colors. A locking system allows one wheel to be partially decoupled from the shaft (for spinning the wheels) so that it may be rotated to the preferred position relative to the first wheel before being locked during operation of the projector.

In one embodiment, timing marks are placed on one or both of the wheels to determine degree of overlap. One wheel or disk is fixedly mounted to a spinning shaft while a second disk is friction mounted to a slip clutch. A braking force is applied to the second disk while the shaft is rotating until the timing mark(s) are sensed to indicate that a correct degree of relative alignment between the disks is present. Then, the braking force is removed to allow the wheels to rotate together.

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